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Directional dependence of depth of correlation due to fluid shear in microscopic particle image velocimetry MICHAEL OLSEN, Iowa State University — An analytical model for the microscopic particle image velocimetry (microPIV) correlation signal peak in a purely shearing flow was derived. This model was then used to derive equations for the measured velocity weighting functions for the two velocity components, and the weighting functions were in turn used to define the depths of correlation associated with the two measured velocity components. The depth of correlation for the velocity component perpendicular to the shear was found to be unaffected by the shear rate. However, the depth of correlation for the velocity component in the direction of the shear was found to be highly dependent on the shear rate, with the depth of correlation increasing as shear rate increased. Thus, in a flow with shear, there is not a single value for the depth of correlation within an interrogation region. Instead, the depth of correlation exhibits directional dependence, with a different depth of correlation for each of the two measured velocity components. The increase in the depth of correlation due to shear rate is greater for large numerical aperture objectives than for small numerical aperture objectives. This increase in the depth of correlation in a shearing flow can be quite large, with increases in the depth of correlation exceeding 100% very possible for high numerical aperture objectives.

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